

THIRD EDITION

Management Information Systems

Effy Oz



Contents

Part I	The Information Age	1
	Case I: The Bike Guys	1
	Chapter 1 Business Information Systems: An Overview	6
	The Bike Guys: In Search of Business Information	6
	<i>Creating Useful Information</i>	6
	<i>Getting a Handle on Data</i>	7
	<i>Information Dictates Pricing and Training</i>	7
	<i>Guaranteeing Their Work</i>	7
	<i>A Sound Information System</i>	7
	Information Systems	8
	Data, Information, and Systems	8
	<i>Data vs. Information</i>	8
	<i>Data Manipulation</i>	8
	<i>Generating Information</i>	9
	<i>Information in Context</i>	10
	<i>What Is a System?</i>	10
	<i>Information and Managers</i>	13
	Why You Should . . . Be Well-versed in Information Systems	14
	<i>The Benefits of Human–Computer Synergy</i>	14
	<i>What Are Information Systems?</i>	15
	<i>The Four Stages of Processing</i>	16
	Ethical and Societal Issues: The Not-so-bright Side	18
	<i>Computer Equipment for Information Systems</i>	20
	ISS: From Recording Transactions to Providing Expertise	20
	<i>Transaction Processing Systems</i>	21
	<i>Management Information Systems</i>	21
	Information Systems in Business	23
	<i>Information Systems in Functional Business Areas</i>	23
	<i>Information Systems in Different Business Sectors</i>	24
	Shared Data Resources	27
	E-Commerce	28
	Why Study Information Systems?	29
	<i>Degrees in IS</i>	30
	<i>Information Systems Careers</i>	31
	Summary	31
	The Bike Guys Revisited	34
	Review Questions	34
	From Ideas to Application: Real Cases	36

Chapter 2	Strategic Uses of Information Systems	40
	The Bike Guys: New Initiatives	40
	<i>Testing Information Strategies</i>	40
	<i>Saved by Information</i>	41
	<i>Information Becomes Strategic</i>	41
	<i>Strategic Success</i>	41
	<i>Following the Moving Target</i>	41
	Strategy and Strategic Moves	42
	Achieving a Competitive Advantage	43
	<i>Initiative #1: Reduce Costs</i>	44
	<i>Initiative #2: Raise Barriers to Entrants</i>	45
	<i>Initiative #3: Establish High Switching Costs</i>	45
	<i>Initiative #4: Create New Products and Services</i>	46
	<i>Initiative #5: Differentiate Products and Services</i>	47
	<i>Initiative #6: Enhance Products or Services</i>	48
	<i>Initiative #7: Establish Alliances</i>	48
	Ethical and Societal Issues: The Power of Information	50
	<i>Initiative #8: Lock In Suppliers or Buyers</i>	52
	Strategic Information as a Competitive Weapon	53
	<i>Creating an SIS</i>	53
	<i>Reengineering and Organizational Change</i>	55
	<i>Competitive Advantage as a Moving Target</i>	55
	<i>Sources of Strategic Information Systems</i>	56
	Why You Should . . . Understand the Notion of Strategic Information Systems	59
	Acumax Plus: An SIS Success	60
	<i>Improving Existing Services</i>	60
	<i>Business Process Redesign</i>	61
	<i>Providing New Services</i>	62
	MortgagePower Plus: An SIS Failure	62
	<i>Identifying the Competitive Advantage</i>	63
	<i>The SIS Plan</i>	63
	<i>How the SIS Failed</i>	63
	<i>Losing Ground</i>	64
	Success and Failure on the Web	64
	The Bleeding Edge	67
	Summary	68
	The Bike Guys Revisited	70
	Review Questions	71
	From Ideas to Application: Real Cases	73
	Chapter 3	Information Systems in Business Functions
		76
	The Bike Guys: Beyond Entrepreneurship	76
	<i>Expanding Operations</i>	77
	<i>Managing Remotely</i>	77
	Effectiveness and Efficiency	77
	Accounting	80
	Why You Should . . . Know about ISs in Different Business Functions	81

Finance	82
<i>Cash Management</i>	82
<i>Investment Analysis and Service</i>	83
Engineering	84
Manufacturing and Inventory Control	86
<i>Materials Requirement Planning</i>	87
<i>Manufacturing Resource Planning</i>	87
<i>Manufacturing Execution Systems</i>	88
Marketing, Sales, and Customer Service	88
<i>Market Research</i>	89
Ethical and Societal Issues: Privacy? What Privacy?	90
<i>Targeted Marketing</i>	92
<i>The Computer as a Marketing and Selling Medium</i>	93
<i>Sales Force Automation</i>	94
<i>Customer Relationship Management</i>	94
Human Resources	95
<i>Employee Record Management</i>	96
<i>Promotion and Recruitment</i>	96
<i>Training</i>	97
<i>Evaluation</i>	98
<i>Compensation and Benefits Management</i>	99
Enterprise Resource Planning	99
Groupware and Collaborative Work	101
<i>Document Control</i>	102
<i>Collaborative Projects</i>	103
<i>Brainstorming</i>	105
Summary	106
The Bike Guys Revisited	107
Review Questions	108
From Ideas to Application: Real Cases	110

Part II Information Technology 113

Case II: Play-it-Again Arcade Games, Inc. 113

Chapter 4 Information Technology in Business: Hardware	118
Play-it-Again Arcade Games, Inc.: Hardware to the Rescue	118
<i>Changing Gears</i>	118
<i>Working with the Consultant</i>	119
The Central Tool of Modern Information Systems	120
<i>What Is a Computer?</i>	120
<i>Business Evolves with Computing</i>	121
Computers Communicating: Bits and Bytes	124
<i>Encoding Schemes</i>	125
<i>Understanding Computer Processing</i>	125
A Peek Inside the Computer	127
<i>The Central Processing Unit</i>	127
<i>Memory</i>	131

Why You Should . . . Understand Some Technical Details	132
<i>Computer Power</i>	133
Input Devices	134
<i>Keyboard</i>	134
<i>QWERTY and Dvorak Keyboards</i>	134
<i>Ergonomic Keyboards</i>	135
<i>Mouse, Trackball, and Track Pad</i>	135
<i>Touch Screen</i>	135
Ethical and Societal Issues: Computers May Be Hazardous to Your Health	136
<i>Source Data Input Devices</i>	137
<i>Imaging</i>	139
<i>Speech Recognition</i>	139
Output Devices	140
<i>Soft-Copy Output Devices</i>	140
<i>Hard-Copy Output Devices</i>	143
External Storage Media	144
<i>Magnetic Tapes</i>	144
<i>Magnetic Disks</i>	145
<i>Optical Discs</i>	146
<i>Optical Tape</i>	148
<i>Flash Memory</i>	148
<i>Business Considerations of Storage Media</i>	148
Classification of Computers	151
<i>Supercomputers</i>	151
<i>Mainframe Computers</i>	151
<i>Minicomputers</i>	152
<i>The Microcomputer Revolution</i>	152
<i>Computers on the Go: Laptop, Hand-held, and Tablet Computers</i>	153
<i>Internet Appliances</i>	155
<i>Reduced Instruction Set Computing</i>	155
<i>Compatibility</i>	156
Considerations in Purchasing Hardware	156
Summary	159
Play-it-Again Games, Inc., Revisited	160
Review Questions	161
From Ideas to Application: Real Cases	163
Chapter 5 Information Systems in Business: Software	166
Play-it-Again Takes Control of Its Finances	166
<i>Ground Zero</i>	167
<i>Laying a Foundation</i>	167
Software: Instructions to the Computer	168
What Is Software?	168
Levels of Programming Languages	169
<i>Machine Languages</i>	169
<i>Assembly Languages</i>	170

<i>Procedural Languages</i>	172
<i>Fourth-Generation Languages</i>	172
<i>Visual Programming</i>	173
<i>Object-oriented Programming</i>	173
<i>Levels of Programming Languages: Pluses and Minuses</i>	176
<i>Language Translation: Compilers and Interpreters</i>	176
Application Software	178
<i>Custom-designed Applications</i>	179
Why You Should . . . Be Software Savvy	179
<i>Packaged Software</i>	181
Ethical and Societal Issues: Software Piracy	184
<i>Multimedia</i>	191
<i>Virtual Reality</i>	192
System Software	193
<i>Operating Systems</i>	193
<i>Data Communications Programs</i>	198
<i>Proprietary vs. Open Source</i>	199
Considerations in Purchasing Software	199
Summary	201
Play-it-Again Revisited	203
Review Questions	204
From Ideas to Application: Real Cases	206
Chapter 6 Information Technology in Business: Telecommunications and Networks	210
Play-it-Again Arcade Games Inc. Gets Connected	210
<i>Getting Connected</i>	211
<i>Long-term Benefits</i>	211
Telecommunications in Business	212
Data Communications	213
Types of Data Communications	214
Communication Direction	215
<i>Simplex</i>	215
<i>Half-duplex</i>	215
<i>Full-duplex</i>	216
Synchronization	216
<i>Asynchronous Communication</i>	216
<i>Synchronous Communication</i>	217
Channels and Media	218
<i>Channel Capacity</i>	218
<i>Media</i>	219
<i>Transmission Speeds</i>	219
<i>Twisted Pair</i>	220
<i>Coaxial Cable</i>	221
<i>Microwaves</i>	222
<i>Optical Fiber</i>	223
Modulation	223
<i>Analog vs. Digital</i>	223

<i>Amplitude Modulation</i>	224
Why You Should . . . Understand Data Communications	225
<i>Frequency Modulation</i>	225
<i>Phase Modulation</i>	225
<i>Modems</i>	225
<i>Multiplexers</i>	227
Networks	228
<i>LANs</i>	229
<i>WANs</i>	229
<i>Network Topology</i>	231
<i>Virtual Private Networks</i>	232
Protocols	233
Ethical and Societal Issues: Telecommuting: Pros and Cons	234
<i>LAN Protocols</i>	236
<i>WAN Protocols</i>	237
Switching Techniques	239
<i>Circuit Switching</i>	240
<i>Packet Switching</i>	240
A Variety of Services	240
<i>Integrated Services Data Networks (ISDN)</i>	242
<i>Cable</i>	242
<i>Digital Subscriber Line (DSL)</i>	242
<i>T1 and T3 Lines</i>	243
<i>Satellite</i>	244
<i>Fixed Wireless</i>	244
<i>Gigabit Ethernet</i>	244
The Changing Business Environment	244
<i>Cellular Phones</i>	245
<i>Videoconferencing</i>	245
<i>Voice Mail</i>	245
<i>Facsimile</i>	246
<i>Web-based Electronic Commerce</i>	246
Summary	246
Play-It-Again Revisited	248
Review Questions	249
From Ideas to Application: Real Cases	250
Chapter 7 E-Commerce: The Internet, Intranets, and Extranets	254
Play-it-Again Arcade Games, Inc.: Play-it-Again-Net	254
<i>Smith Buys In</i>	254
What Is the Internet?	256
<i>The Development of the Internet</i>	257
Why You Should . . . Learn about the Internet	257
<i>Growth of the Internet</i>	258
Internet Domains	260
<i>Domain Names</i>	261
<i>Static and Dynamic IP Numbers</i>	261
<i>What's on the Internet?</i>	262

The World Wide Web	266
<i>Browsers</i>	266
<i>Web Software</i>	267
 Ethical and Societal Issues: Online Free Speech	272
Intranets and Extranets	275
Establishing an E-Commerce Web Site	277
<i>Dedicated Server</i>	277
<i>ISP Site</i>	277
<i>Web Portal</i>	277
<i>Electronic Storefront</i>	278
<i>Web Hosting Service</i>	278
<i>Virtual Web Server</i>	278
<i>Subdomain</i>	279
<i>Considerations in Selection of a Web Service Provider</i>	279
<i>More than Meets the Eye</i>	280
E-Commerce Practices on the Internet	281
<i>Business-to-Business Trading</i>	282
<i>Business-to-Consumer Trading</i>	284
<i>E-Government</i>	290
<i>Web Demographics</i>	291
<i>Rules for Successful Business Web Page Design</i>	292
<i>Rules for Successful Online Business Transactions</i>	292
<i>Successful Business Models</i>	294
<i>M-Commerce</i>	295
Summary	296
Play-it-Again Revisited	298
Review Questions	299
From Ideas to Application: Real Cases	301
Chapter 8 Data and Knowledge Management	306
Play-it-Again Arcade Games Inc.: Pulling It All Together	306
<i>A Database Blueprint</i>	306
<i>Marketing Wants More</i>	307
Managing Digital Data	308
 Why You Should . . . Know about Data and Knowledge Management	308
<i>The Traditional File Approach</i>	309
<i>Moving to Databases</i>	310
<i>Traditional Files vs. Databases: Pros and Cons</i>	314
Database Models	315
<i>The Hierarchical Model</i>	316
<i>The Network Model</i>	317
<i>The Relational Model</i>	318
<i>Keys</i>	319
<i>The Object-oriented Structure</i>	321
<i>Entity-relationship Diagrams</i>	322
Components of Database Management Systems	323
<i>The Schema</i>	324
<i>The Data Dictionary</i>	325

<i>The Data Definition Language</i>	326
<i>The Data Manipulation Language</i>	327
Relational Operations	328
<i>Data Manipulation</i>	328
<i>Structured Query Language</i>	329
Popular Database Management Systems	330
Database Architecture	330
<i>Distributed Databases</i>	330
<i>Shared Resource and Client/Server Systems</i>	332
Web Databases	335
<i>Databases on the Web</i>	335
Ethical and Societal Issues: A Too-Risky Info Highway	336
<i>Points to Consider</i>	338
Data Warehousing	338
<i>From Database to Data Warehouse</i>	340
<i>Phases in Building a Data Warehouse</i>	341
Data Mining	341
Knowledge Management	343
Summary	344
Play-it-Again Revisited	346
Review Questions	347
From Ideas to Application: Real Cases	349

Part III Information Technology in Management 353

Case III: Secor Enterprises 353

Chapter 9 Managers and Their Information Needs 358

Secor Books: Secor and Fixit Get Together	358
<i>Fixit's Information Problem</i>	359
<i>Corporate Reorganization</i>	359
<i>The Information Challenge</i>	359
Managers and Information	360
The Traditional Organizational Pyramid	360
<i>Clerical and Shop Floor Workers</i>	361
<i>Operational Management</i>	362
<i>Tactical Management</i>	362
<i>Strategic Management</i>	362
Characteristics of Information at Different Managerial Levels	363
<i>Data Range</i>	364
Why You Should . . . Be Information-conscious 364	
<i>Time Span</i>	365
<i>Level of Detail</i>	365
<i>Source: Internal vs. External</i>	365
<i>Structured and Unstructured Data</i>	366
The Web: The Great Equalizer	365
The Nature of Managerial Work	368
<i>Planning</i>	368

<i>Controlling</i>	369
<i>Decision Making</i>	370
<i>Managing by Exception</i>	371
<i>Leading</i>	371
Ethical and Societal Issues: Electronic Monitoring of Employees	372
Trends in Organizational Structure	374
<i>IT Flattens the Organization</i>	374
<i>The Matrix Structure</i>	375
Characteristics of Effective Information	377
<i>Tabular and Graphical Representation</i>	377
<i>Online Analytical Processing</i>	377
<i>Dynamic Representation</i>	380
Managers and Their Information Systems	381
<i>Transaction Processing Systems</i>	381
<i>Decision Support Systems and Expert Systems</i>	382
<i>Executive Information Systems</i>	383
<i>Customer Relationship Management Systems</i>	383
Information, Politics, and Power	384
<i>Politics</i>	384
<i>Power</i>	385
<i>The Not-invented-here Phenomenon</i>	386
Summary	387
Secor Books Revisited	388
Review Questions	389
From Ideas to Application: Real Cases	391
Chapter 10 Organizing Information Technology Resources	396
Secor Books: Secor's Expanding Operation	396
<i>Different Information Styles</i>	396
<i>Making a Choice</i>	397
<i>Paying for IS Services</i>	397
<i>Getting the New System Working</i>	397
Information Systems Architecture and Management	398
<i>Centralized Information Systems Architecture</i>	399
<i>Decentralized Information Systems Architecture</i>	399
<i>Distributed Information Systems</i>	400
<i>Centralized vs. Decentralized ISs: Advantages and Disadvantages</i>	401
Organizing the IS Staff	404
<i>Central IS Organization</i>	405
<i>Functional IS Organization</i>	406
<i>The Best of Both Approaches</i>	407
Challenges for IS Managers and Line Managers	408
<i>Line Managers' Expectations of an IS Unit</i>	408
Why You Should . . . Be Interested in the Deployment of ISs	409
<i>IS Manager Expectations of Line Managers</i>	410
The Information Center	411
<i>Coordination and Control</i>	411
Charge-back Methods	413

<i>Service Charges</i>	413
<i>Overhead Expenditures</i>	414
Careers in Information Systems	415
<i>The Systems Analyst</i>	415
■ Ethical and Societal Issues: Gearing for IT Skills	416
<i>The Database Administrator</i>	418
<i>The Telecommunications Manager</i>	419
<i>The Webmaster</i>	419
<i>The Chief Information Officer and the Chief Technology Officer</i>	420
<i>The Chief Knowledge Officer</i>	421
<i>The Independent Consultant</i>	422
Summary	422
Secor Books Revisited	424
Review Questions	425
From Ideas to Application: Real Cases	426
Chapter 11 EDI, Supply Chain Management, and Global Information Systems	430
Secor Press: Online for Business	430
<i>Electronic Streamlining</i>	431
<i>The Next Step</i>	431
<i>McCourt's Challenges</i>	431
<i>Business on the Web</i>	431
Sharing Information Systems: The Rise of E-Commerce	432
Vertical Information Interchange	433
Horizontal Information Interchange	435
Why You Should . . . Learn about Interorganizational and Global ISs	436
Electronic Data Interchange	438
<i>Value Added Network EDI</i>	441
<i>Web EDI</i>	442
Supply Chain Management	443
International and Multinational Organizations	446
Using the Web for International Commerce	448
Challenges to Global Information Systems	450
<i>Technological Challenges</i>	451
<i>Differences in Payment Mechanisms</i>	451
<i>Language Differences</i>	452
<i>Cultural Differences</i>	452
<i>Conflicting Economic, Scientific, and Security Interests</i>	453
<i>Political Challenges</i>	453
<i>Lack of Standards</i>	454
<i>Legal Barriers</i>	455
Ethical and Societal Issues: Legal Jurisdictions in Cyberspace	456
The Latecomer Benefit	459
Summary	460
Secor Enterprises Revisited	461
Review Questions	462
From Ideas to Application: Real Cases	464

Part IV	Information Systems in Decision Making	467
	Case IV: Ross Venture Capital Fund	467
	Chapter 12	Decision Support and Geographic Information Systems 472
	Ross Venture Capital Fund: Deciding on Decision Aids	472
	<i>A Change of Mind</i>	472
	<i>Johnson's Analysis</i>	473
	<i>Getting Started</i>	473
	Decision Making in Business	474
	The Decision-Making Process	474
	Structured and Unstructured Problems	475
	<i>Structured Problems</i>	475
	<i>Unstructured Problems</i>	477
	<i>Semistructured Problems</i>	477
	<i>Managers and Semistructured Problems</i>	478
	Decision-Support System Components	479
	<i>The Data Management Module</i>	480
	Ethical and Societal Issues: Decisions by Machines	482
	<i>The Model Management Module</i>	483
	<i>The Dialog Module</i>	485
	Types of Decision-Support Systems	487
	<i>Personal Decision-Support Systems</i>	488
	<i>Group Decision-Support Systems</i>	490
	Sensitivity Analysis	492
	Executive Information Systems	492
	Developing Decision-Support Systems	493
	<i>When Should a DSS Be Built?</i>	494
	The Electronic Spreadsheet: A DSS Tool	495
	Geographic Information Systems	496
	Why You Should . . . Be Familiar with Decision-Support Systems	496
	Summary	498
	Ross Venture Capital Fund Revisited	499
	Review Questions	500
	From Ideas to Application: Real Cases	502
	Chapter 13	Artificial Intelligence and Expert Systems 506
	Ross Venture Capital Fund (RVCF): Meet The Ross	506
	<i>Intellicision Gets Started</i>	507
	<i>Learning More</i>	507
	<i>Intellicision Delivers</i>	507
	Artificial Intelligence in Business	508
	<i>Robotics</i>	508
	<i>Artificial Vision</i>	510
	<i>Natural Language Processing</i>	510
	<i>Expert Systems</i>	511
	Ethical and Societal Issues: Too Sophisticated Technology	512
	<i>Neural Networks</i>	513
	<i>Fuzzy Logic</i>	515

<i>Genetic Algorithms</i>	517
<i>Intelligent Agents</i>	519
Contribution of Expert Systems	520
Development of Expert Systems	521
<i>What Is Expertise?</i>	521
Why You Should . . . Recognize the Potential of Artificial Intelligence	522
<i>Components of Expert Systems</i>	523
Construction of Expert Systems	523
<i>IF-THEN Rules</i>	524
<i>Frames</i>	525
<i>Semantic Nets</i>	525
<i>Knowledge Engineering</i>	525
<i>Expert System Shells</i>	527
<i>Forward Chaining and Backward Chaining</i>	528
<i>Factors Justifying the Acquisition of Expert Systems</i>	529
Expert Systems in Action	529
<i>Telephone Network Maintenance</i>	529
<i>Credit Evaluation</i>	530
<i>Tax Planning</i>	530
<i>Detection of Insider Securities Trading</i>	531
<i>Detection of Common Metals</i>	531
<i>Mineral Exploration</i>	531
<i>Irrigation and Pest Management</i>	531
<i>Predicting Failure of Diesel Engines</i>	532
<i>Medical Diagnosis</i>	532
<i>Class Selection for Students</i>	533
Limitations of Expert Systems	533
Summary	534
Ross Venture Capital Fund Revisited	536
Review Questions	537
From Ideas to Application: Real Cases	539

Part V Planning, Acquisition, and Controls 543

Case V: Metropolitan Hospital 543

Chapter 14 Planning Information Systems 548

Metropolitan Hospital: Plans for TIMM's Arrival 548

System Development Begins 548

A Proposal Is Born 549

Why Plan? 550

What Is Planning? 550

Business Planning 550

Approaches to Planning 551

Top-down Planning 552

Bottom-up Planning 552

Planning by Critical Success Factors 553

Information Systems Planning	554
<i>Prerequisites for Information Systems Planning</i>	557
<i>The Corporate and IS Mission Statements</i>	558
<i>The IT Vision</i>	559
<i>Strategic and Tactical Information Systems Planning</i>	559
Ethical and Societal Issues: Codes of Ethics for IS Professionals	560
<i>Important Factors in IS Tactical Planning</i>	562
IS Planning Initiatives	564
Why You Should . . . Be Involved in IS Planning	565
<i>The Champion</i>	566
<i>The Systems Analyst as an Agent of Change</i>	567
<i>Summary</i>	569
<i>Metropolitan Hospital Revisited</i>	570
<i>Review Questions</i>	571
<i>From Ideas to Application: Real Cases</i>	573
Chapter 15 Systems Development	576
<i>Metropolitan Hospital: Developing TIMM</i>	576
<i>From Planning to Development</i>	577
<i>The Board Meeting</i>	577
<i>Why Develop an IS?</i>	578
<i>The Systems Development Life Cycle</i>	578
<i>Analysis</i>	579
Why You Should . . . Understand the Principles of Systems Development	585
<i>Design</i>	586
<i>Implementation</i>	593
Ethical and Societal Issues: Should IS Professionals Be Certified?	594
<i>Support</i>	598
Prototyping	599
<i>When to Prototype</i>	601
<i>When Not to Prototype</i>	602
Computer-aided Software Engineering	603
Project Management	603
<i>Project Management Goals</i>	606
<i>Project Management Functions</i>	607
Systems Development Led by End Users	609
<i>JAD: An Example of User-led Systems Development</i>	609
Systems Integration	611
Summary	612
<i>Metropolitan Hospital Revisited</i>	614
<i>Review Questions</i>	615
<i>From Ideas to Application: Real Cases</i>	617
Chapter 16 Alternative Avenues for Systems Acquisition	622
<i>Metropolitan Hospital: Looking Outside for Help</i>	622
<i>Regrouping</i>	622
<i>Akers Backs the New Plan</i>	623

<i>Revisiting the Board</i>	623
<i>Finding the Right Software</i>	623
Sources of Information	624
Why You Should . . . Understand Alternative Avenues for the Acquisition of Information Systems	626
Outsourcing	626
<i>Advantages of Outsourcing</i>	628
<i>Risks of Outsourcing</i>	630
Purchased Applications	632
<i>Why Purchase?</i>	632
<i>Steps in Purchasing Ready-made Software</i>	633
<i>Benchmarking</i>	636
<i>Learning from Experience</i>	637
<i>Purchasing Risks</i>	637
Ethical and Societal Issues: Computer Use Policies for Employees	638
<i>Legislation to Protect Software Vendors</i>	639
<i>Licensing under .NET</i>	640
Renting Software	640
Application Service Providers	641
<i>The ASP Industry</i>	643
<i>Caveat Emptor</i>	644
The Information Systems Subsidiary	645
User Application Development	646
<i>Factors Encouraging User Application Development</i>	647
<i>Managing User-developed Applications</i>	649
<i>Advantages and Risks</i>	650
Summary	651
Metropolitan Hospital Revisited	653
Review Questions	654
From Ideas to Application: Real Cases	656
Chapter 17 Risks, Controls, and Security Measures	660
Metropolitan Hospital: Calling all Guards	660
<i>Resident Skeptic</i>	660
<i>Don't Throw Away the Paper</i>	661
<i>Balancing Access and Operations</i>	661
Goals of Information Security	662
Risks to Information Systems	662
<i>Risks to Hardware</i>	663
<i>Risks to Applications and Data</i>	665
Why You Should . . . Understand Controls and Security Measures in Information Systems	668
Risks to Online Operations	672
<i>Denial of Service</i>	672
<i>Spoofing</i>	673
Controls	673
<i>Program Robustness and Data Entry Controls</i>	673
<i>Backup</i>	675
<i>Access Controls</i>	676

Atomic Transactions 677

Audit Trail 679

Encryption 679

Ethical and Societal Issues: Clippers, Carnivores, and Echelons 680

Encryption Strength 683

Distribution Restrictions 684

Public Key Encryption 684

Secure Sockets Layer and Secure Hypertext Transport Protocol 685

Pretty Good Privacy 686

Digital Signatures and Digital Certificates 686

Electronic Signatures 687

Digital Signatures 687

Digital Certificates 689

Firewalls 691

Security Standards 693

The Orange Book 693

The ISO Standard 694

The Downside of Security Controls 695

Recovery Measures 695

The Business Recovery Plan 696

Outsourcing the Recovery Plan 698

The Economic Aspect of Security Measures 698

Summary 700

Metropolitan Hospital Revisited 702

Review Questions 703

From Ideas to Application: Real Cases 705

MEASUREMENT UNITS 708

GLOSSARY 709

INDEX 731